CATALOG NO. 2-11

1963-64 Catalog

COMPONENTS FOR TEST CONSOLES

Theta

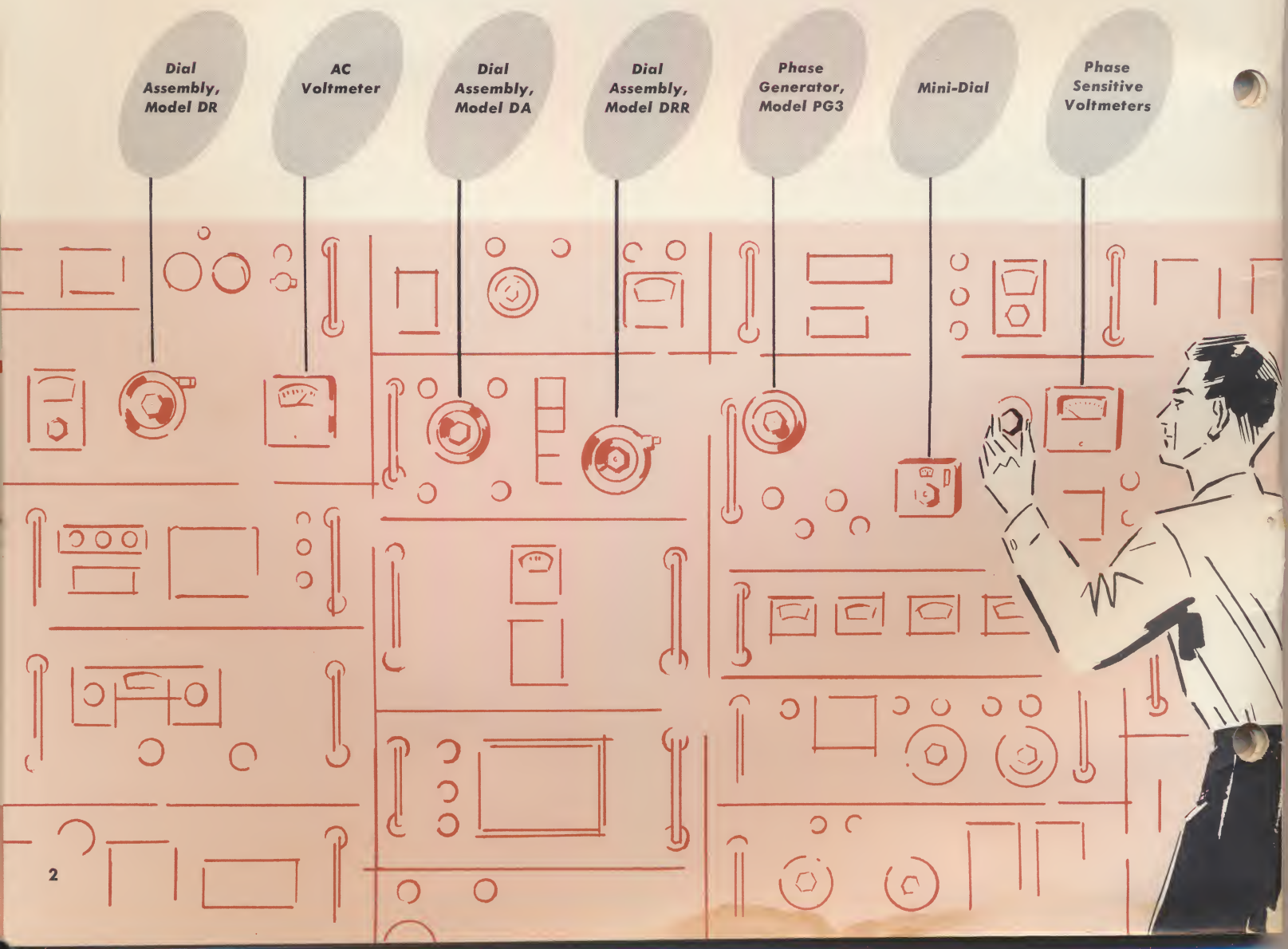
INSTRUMENT CORPORATION

CREATIVE ELECTRONICS / PRECISION MECHANICS

To The Test Equipment Designer:

THETA PRODUCTS ARE ENGINEERED FOR USE ON TEST PANELS

- Easy to integrate and avoid that "patch-work" look
- Simple to operate
- Occupies a minimum of space
- Accurate to laboratory standards without laboratory-instrument complexity
- Rugged construction

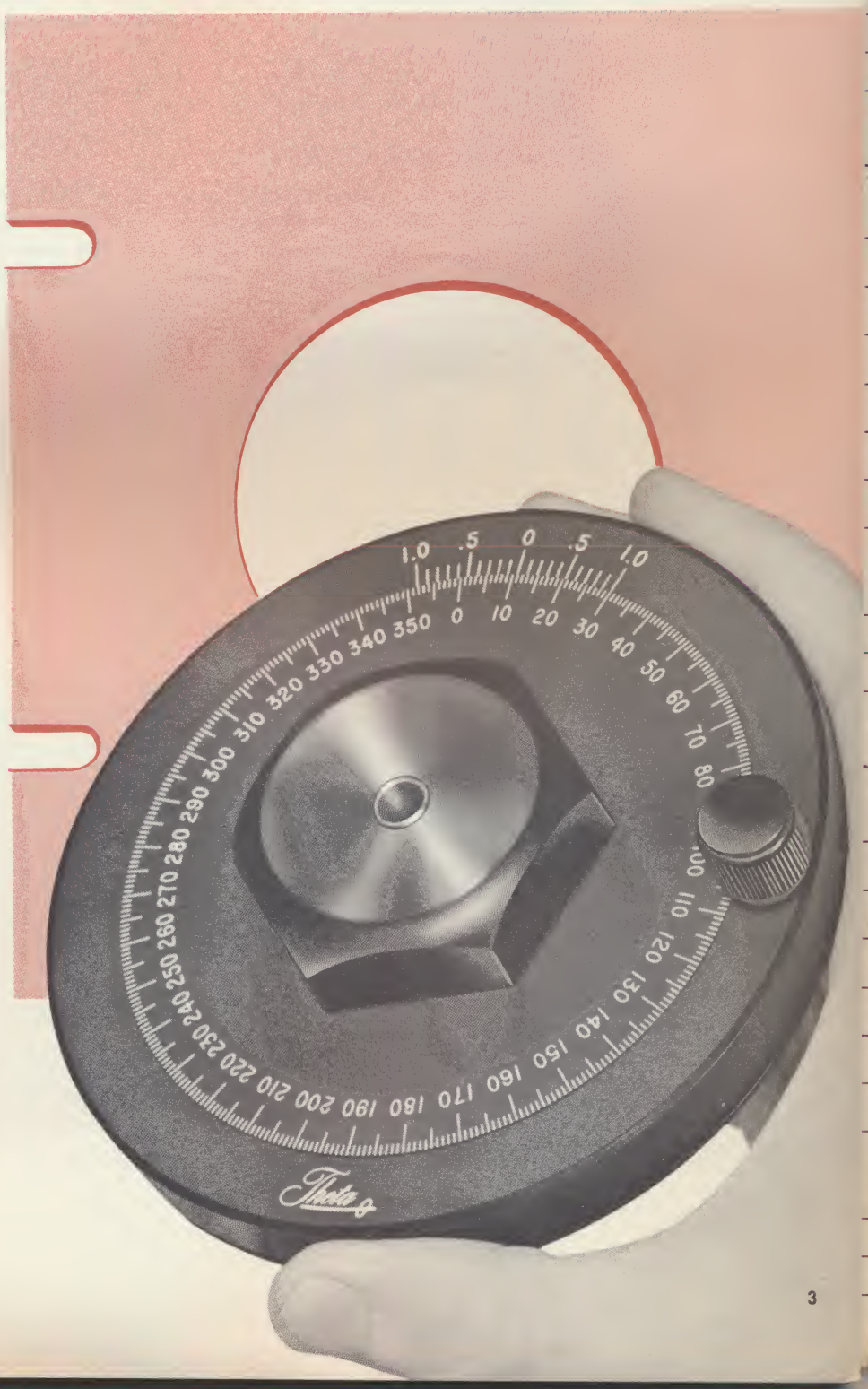


PANEL-MOUNTED, SUPERIOR QUALITY

DIAL ASSEMBLIES

DELIVERY FROM STOCK . . .

Used for the angular positioning of synchros, resolvers, potentiometers, inductors, capacitors, digital encoders, tuning coils and other rotating devices. Just plug in your component and the Dial Assembly is ready for use. Designed for mounting on any panel without disassembly.



THREE MODELS AVAILABLE . . .

DIAL ACCURACY

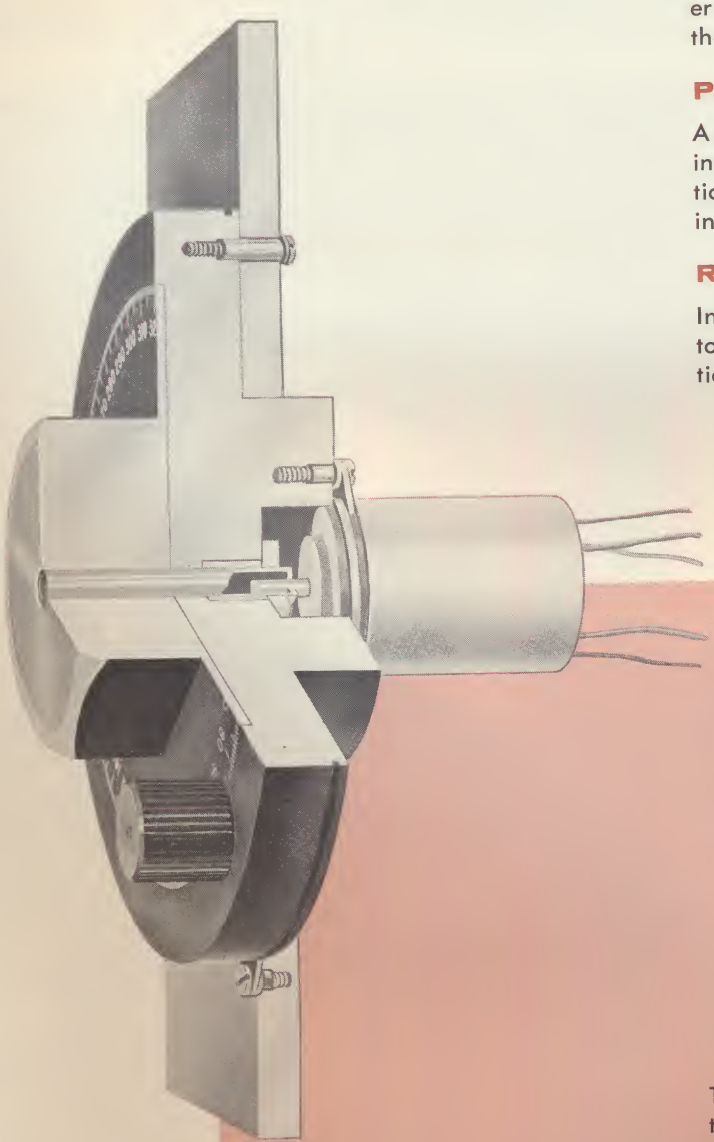
The dial is graduated in 1° intervals through 360°. A vernier scale allows readings to the nearest 0.1° (.025° in the Model DRR). Since the reading dial is directly connected to the output shaft, coupling errors are completely absent. At the vernier knob there is zero backlash. Each dial is accurate to 0.1°.

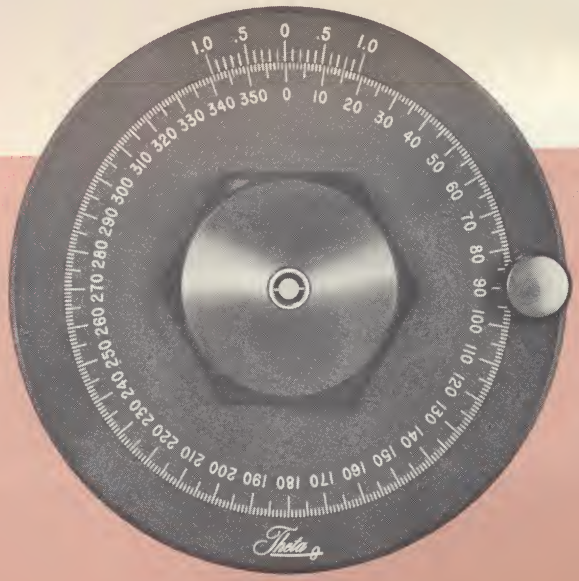
PROVISION FOR ZEROING

A coaxial hole through the assembly permits zeroing of the synchro or pot relative to the dial indication. Insertion of a screwdriver engages the slot in the component shaft, slipping it in the collet.

RAPID TURNING

In all models, the large knob is directly connected to the shaft of the servo-mounted device. One rotation of this knob will rotate the shaft through 360°.





MODEL DA

Ten turns of the small knob will rotate the shaft through 360°. Use to drive light loads such as synchros and single potentiometers.

These Dial Assemblies are used in the electronic support consoles of many missile systems where quality appearance is a necessity. They dress up any panel — from both the front and the rear.

RUGGED

The basic housing is precision machined from solid five-inch diameter aluminum stock. To this may be attributed the structural rigidity and the dimensional stability of the completed assembly. After being submitted to various military tests which included 50 hours at −55°F., 50 hours at +160°F., and 240 hours of humidity, the Dial Assembly operation and appearance were unaffected.

ACCEPTS ANY SERVO-MOUNTED DEVICE

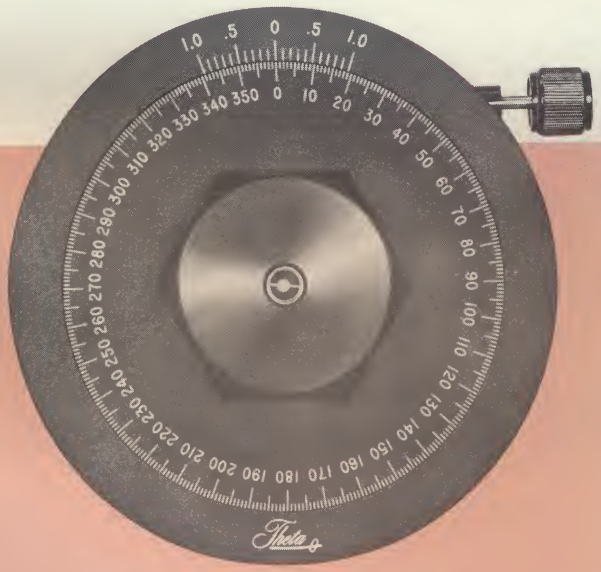
The synchro or potentiometer is inserted into a spring-loaded collet. By means of Theta's servo-mounting clamps, the housing is held rigidly. Additional fixturing is not required.

CONVENIENT PANEL-MOUNTING

Either of two methods is used to mount the Dial Assembly to the panel. The peripheral surface is grooved to allow clamping to the panel in the same manner a synchro is clamped. With this method the Dial Assembly can be easily removed from the face of the panel. The alternate mounting employs three tapped holes on the rear surface. Screws are inserted from the inside of the panel for permanent installation. A 2 9/16 inch diameter hole is punched in the panel for either mounting choice. May be mounted on a panel of any thickness.

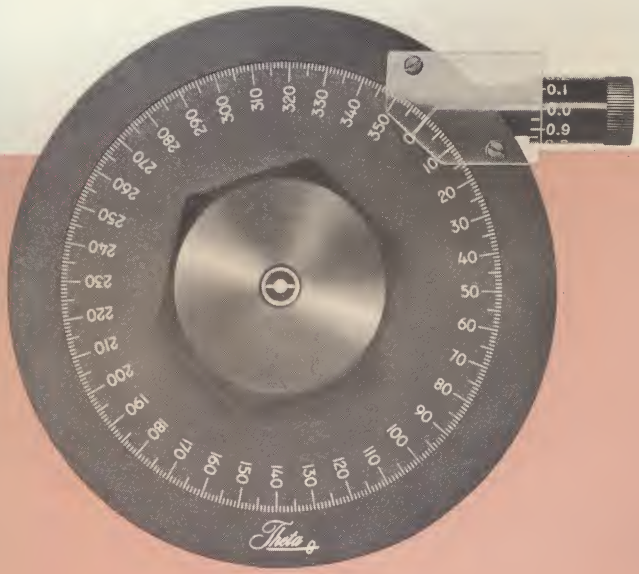
POSITIVE SHAFT CLAMPING

The pressure of the split collet upon the synchro or potentiometer shaft may be increased by means of an adjustable hub located on the collet. It ensures zero slippage as a function of rotation.



MODEL DR

1,440 turns of the small knob will rotate the shaft through 360°. Recommended when a high degree of set-ability is required. Sufficient ratio between vernier knob and component rotor permits comfortable positioning within 10 sec.-of-arc. Will drive heavy loads such as ganged potentiometers. Slip clutch disengages automatically to prevent damage to a component's stops.



MODEL DRR

Digital reading on the drum eliminates vernier interpolation. 360 turns of the drum rotates the shaft through 360°. Will drive heavy loads. Has slip clutch to prevent damage to a component's stops. Pushing the drum to the left enables it to be zeroed without rotating any other part of the mechanism.

SPECIFICATIONS

Rotation . . . . . Continuous, 0° through 360°, CW or CCW.

Rotation Sense . . . . . CCW rotation of output shaft (facing dial) equivalent to positive increasing angle on dial.

Markings . . . . . Dial graduated in 1° intervals and vernier dial in 0.1° intervals (.05° interval on Model DRR)

Dial Accuracy . . . . . 0.1°

Dial Readability . . . . . 0.1° (.025° on Model DRR)

Ratio, Large Knob to Output Shaft 1:1

Range, Vernier Knob . . 360°, Continuous

MODEL DA

Ratio, Vernier Knob to Output Shaft 10:1

MODEL DR

Ratio, Vernier Knob to Output Shaft 1440:1

MODEL DRR

Ratio, Vernier Knob to Output Shaft 360:1

SPECIAL SCALES

0 to 100 100 divisions. Every 5th division numbered. CCW rotation of output shaft (facing dial) equivalent to increasing numbers.

±180° 360 divisions. Every 10th division numbered. Marked positive 180° and negative 180° with respect to 0°.

0° to 360°, CW Same as standard scale, except that CW rotation of output shaft (facing dial) equivalent to positive increasing angles.

OTHER CUSTOM MODIFICATIONS

Vernier Ratio . . . . . Any ratio between 36 and 1440 can be provided.

Collet Size . . . . . Any one size between .060 in. dia. and .250 in. dia. may be chosen.

Special rear mounting . Mounting holes for any one component up to 2½ in. dia. are available to order.

ORDERING INFORMATION

Dial Assemblies are manufactured to accept servo-mounted devices of the following description:

HOUSING SIZE

(choose one only): 8, 10, 11, 15, 18, 23, 25

NOMINAL SHAFT DIAMETER

(choose one only): 0.090, 0.120, 0.125, 0.1875, 0.2405, 0.250

When ordering, suffix both housing size and shaft diameter to the Model No. as in this example: Model DA-11-.120 accommodates a Size 11 component with .120 in. dia. shaft.

F.O.B. ..... Saddle Brook, N. J.
TERMS ..... ½%, 10 days; Net 30 days
SHIPPING WT. ..... Approx. 2 lb.
WARRANTY ..... 90 days

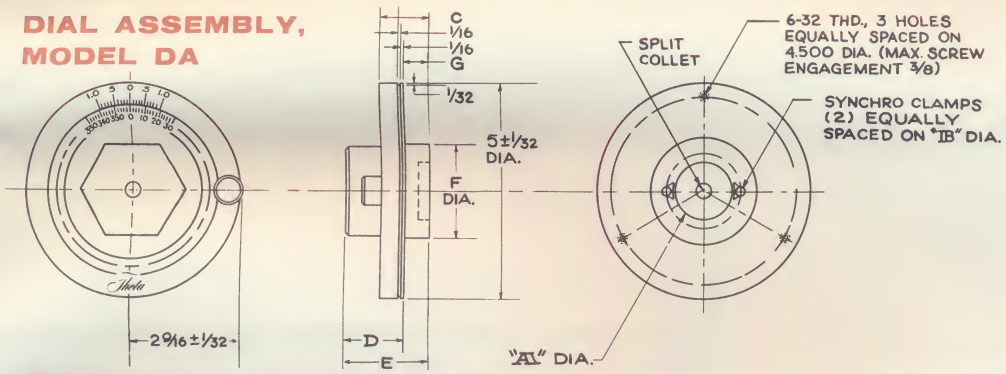
MODEL DA

MODEL DR

MODEL DRR

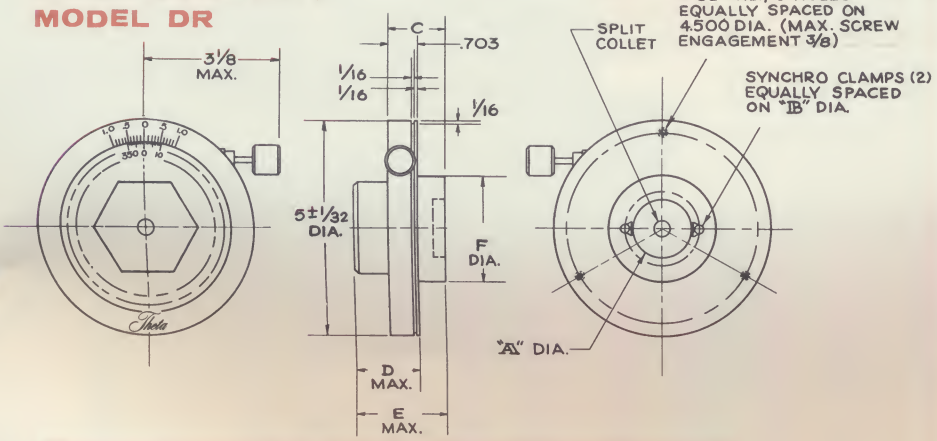
DIAL ASSEMBLY OUTLINE DRAWINGS

DIAL ASSEMBLY, MODEL DA



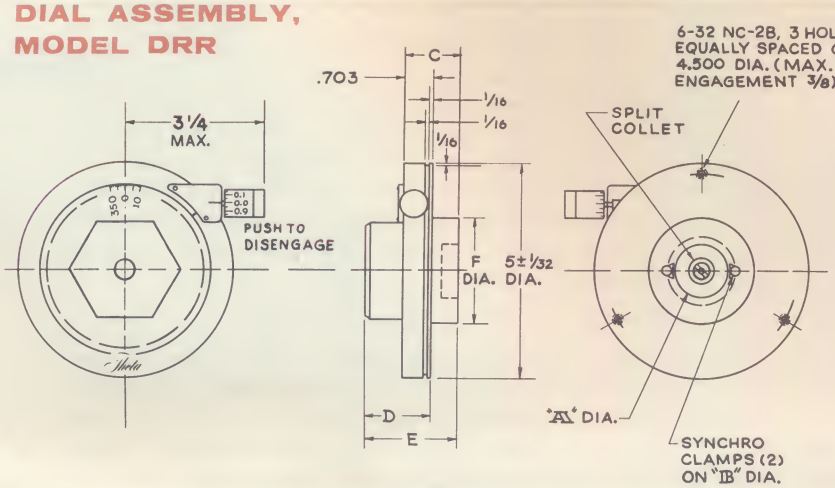
Dimension	Size 8-18	Size 23	Size 25
C	1-13/64	1.488	1-9/32
D	1-7/32 ±1/32	1.187	1-7/32 ±1/32
E	1-27/32 ± 1/32	2-1/8 Max.	1-15/16 ±1/32
F	2.465	2.875	3.000
G	5/8	0.917	23/32

DIAL ASSEMBLY, MODEL DR



Dimension	Size 8-18	Size 23	Size 25
C	1.328	1.671	1.671
D	1.375	1.718	1.365
E	2.000	2.343	2.332
F	2.465	2.875	3.000

DIAL ASSEMBLY, MODEL DRR



Dimension	Size 8-18	Size 23	Size 25
C	1.328	1.671	1.671
D	1.359	1.359	1.359
E	1.984	2.328	2.328
F	2.465	2.875	3.000

COMPONENT SIZE	DIA. "A" ± .005	DIA. "B" ± .005
8	0.508	1.011
10	0.820	1.195
11	0.010	1.325
15	1.322	1.693
18	1.573	2.008
23	2.008	2.526
25	2.321	2.745

Unless otherwise specified, dimensions are in inches
± .015 on fractions
± .005 on decimals

MINI-DIAL®

MINIATURE DIAL ASSEMBLY

IMMEDIATE DELIVERY FROM STOCK

- Small Size
- High Set-Ability
- Mounting Ease
- Excellent Appearance

The MINI-DIAL mounts to any shaft and panel

USE THE MINI-DIAL AS A...

MECHANICAL GAIN CONTROL — for pots, tuning coils, capacitors, and autotransformers

ANGULAR POSITIONER — for synchros, resolvers, and function generators

VERNIER CONTROL

A vernier knob is geared 100:1 with respect to the output shaft to attain precise settings. Each turn of the vernier knob thus rotates the output shaft 3.6°. For rapid turning, another knob is geared 1:1. Positive integral locking prevents movement of the output shaft due to jarring or vibration. A slip-clutch prevents damage to devices which have stops. There is also a provision for zeroing the dial with respect to the output shaft in a simple manner.

SIMPLE PANEL-MOUNTING

The MINI-DIAL is pushed over any shaft which extends from a panel. Its spring-loaded collet grabs hold and may be tightened to any degree. By means of two tapped holes in the panel and two clearance holes in the MINI-DIAL the entire assembly is fastened to the panel. The MINI-DIAL does not have to be disassembled for mounting. Regardless of panel thickness, the MINI-DIAL is easily mounted.

PRECISION CONSTRUCTION

Rugged MIL type construction will pass the environmental extremes. Completely geared, the MINI-DIAL drives loads of high breakaway torque. There is no backlash. Operation is quiet and lubrication is never necessary.

SPECIFICATIONS

Rotation . . . . . 0° through 360°, continuous, CW or CCW

Rotation Sense . . . . . CCW rotation of output shaft (facing MINI-DIAL) equivalent to positive increasing numbers on dial.

Graduations: . . . . . 180 divisions on angular scales; 200 divisions on 0-100 scales

Graduation Accuracy 12 min.-of-arc

Coarse Knob Ratio 1:1

Fine Knob Ratio 100:1

Finish . . . . . Dull black with white markings

ORDERING INFORMATION

Collet Size . . . . . Standard collets are designed to accept one of the following nominal shaft diameters: .090, .120, .125, .1875, .2405, .250. When ordering, suffix the shaft diameter to the Model No.

Model MD-A . . . . . Scale graduated 0° through 360°

Price . . . . . .

Model MD-B . . . . . Scale graduated 0 through 100

Price . . . . . .

Extra Collets . . . . . .

F.O.B.: ..... Saddle Brook, N. J.
Shipping Wt. Approx. ..... 1 lb.
Warranty: ..... 90 days
Terms: ..... ½%, 10 days; net 30 days

SPECIAL SCALES

0° through 360° with 1° graduations

There are twice as many graduations as on the Model MD-A. Designated as MINI-DIAL, Model MD-C, it is priced at plus a set-up charge of per order.

a) ± 180° with divisions every 2°
b) 0°-360°, CW
c) 0-100, CW

Same as standard scales, except that CW rotation of output shaft (facing MINI-DIAL) equivalent to positive increasing numbers on dial.

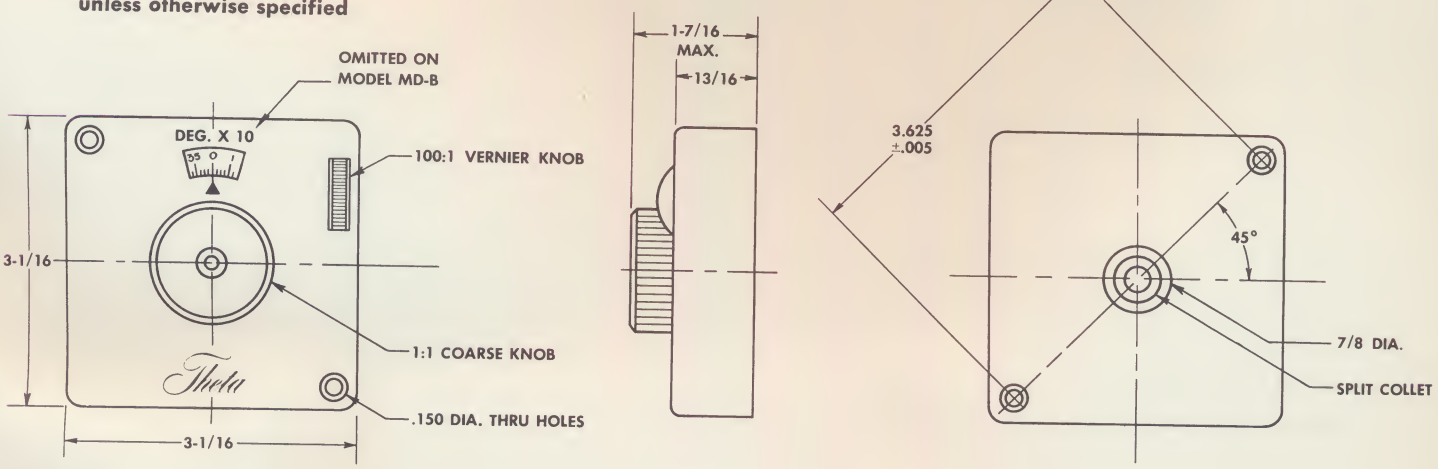
OTHER CUSTOM MODELS

Servo mountings. The rear surface of the MINI-DIAL may be modified to provide a mounting for any servo component up to Size 15.

Collet Size. Any one size between .090 in. dia. and .250 in. dia. may be chosen.

MINI-DIAL OUTLINE DRAWING

±.015 on fractions
±.005 on decimals
unless otherwise specified



AC VOLTMETERS

TRVM

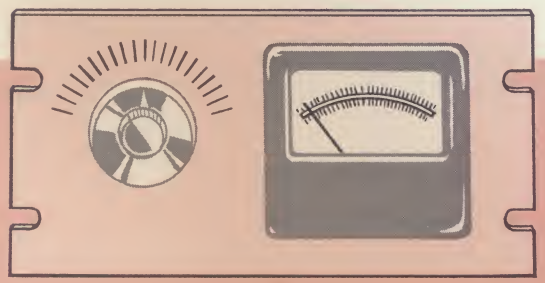
PHASE-SENSITIVE VOLTMETERS

PSVM

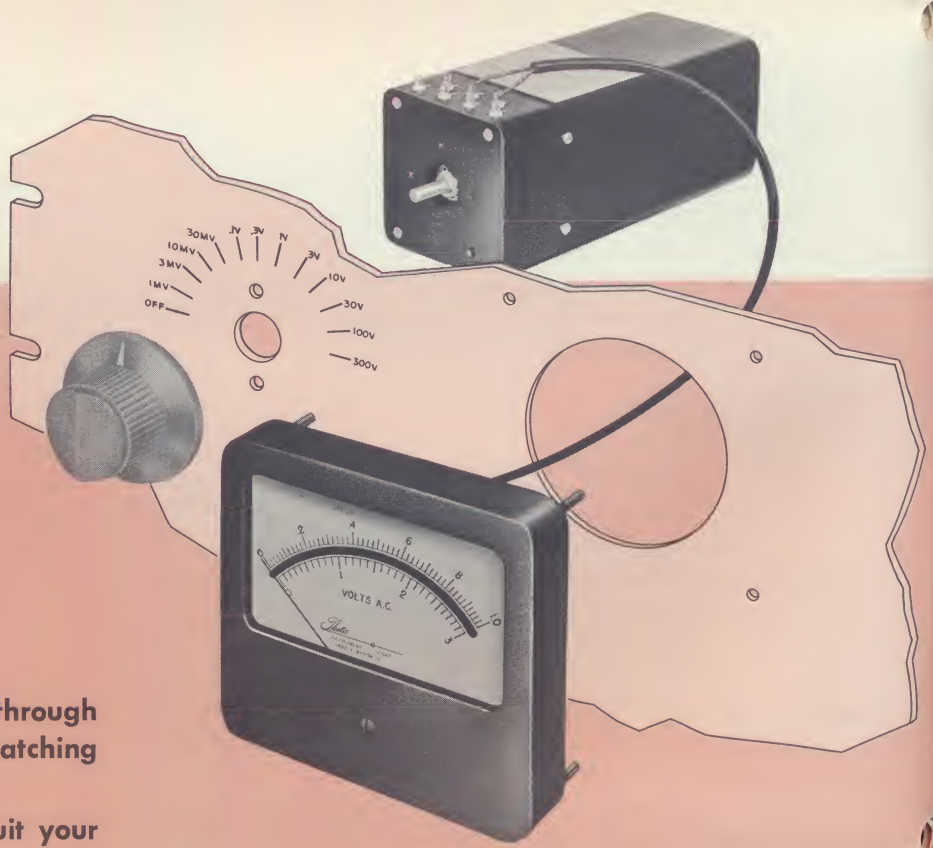
SOLID-STATE, MULTI-RANGE VOLTMETERS

IMMEDIATE DELIVERY FROM STOCK

Theta voltmeters are sophisticated instruments which have been reduced to component simplicity. These panel-mounted modules are built-into all kinds of test systems to simplify operation, preserve space, and enhance appearance. Apply them as you would any laboratory AC-voltmeter or phase-sensitive voltmeter.



Shown assembled



- **Only the range switch protrudes through the panel. No concern about matching finishes, knobs, or markings.**
- **Locate the meter (any style) to suit your human engineering and packaging requirements.**

OFFERING COMPLETE PANEL DESIGN FREEDOM

SMALLEST, PANEL-MOUNTED METERS EVER PRESENTED

With two easy-to-mount sections, panel space is most efficiently used. Mount the meter alongside, above, below, or away from the electronic package.

HUMAN ENGINEERED

Many designed-for-use panels require meters at eye level and controls at hand level. Only with Theta solid-state voltmeters can this be done.

NEAT APPEARANCE

Theta voltmeters are built-into your test panels. Problems of matching paint finishes, knobs, markings, and meter movements to the rest of your test system have been eliminated. Since the meter movement is a separate element, a style and size may be chosen to match the other panel meters being used.

RUGGED CONSTRUCTION

Withstands the rigorous environmental requirements of most military specifications for ground support equipment. Ruggedization includes the use of fungus-inert materials, body-strapping of oversize components, and die-cast aluminum frame.

SOLID-STATE RELIABILITY

Fully transistorized design assures longer life, less maintenance, less power drain, and more stability than vacuum tube counterparts. These instruments are ready for instant operation without warmup.

ISOLATION OF ALL ELECTRICAL CIRCUITS TO AVOID GROUND LOOPS

The signal and power circuits are fully isolated one from the other (except in the case of 28 V DC power options). If desired, leads may be commoned thus enabling the designer to carry wires to a single point for grounding.

CHOOSE YOUR OWN METER STYLE

Theta stocks three sizes of rectangular, mirror-scale meter movements for use with solid-state voltmeters. Separation of electronics and meter allows the choice of any meter (electrical parameters must conform).

FASTEST RESPONSE

Input signals which differ considerably in amplitude are rapidly read upon Theta voltmeters. For example, should a particular scale be saturated with 300 V and then a 1 MV signal inserted— the transients will settle out in less than half-a-second. Thus, a sequence of voltage measurements is actually performed in a shorter time.

FULLY OVERLOAD-PROTECTED

Up to 350 V may be continuously inserted at the voltmeter input — even on the 1 MV scale — without any damage whatever to either the circuitry or the meter movement. Amplifier saturation protects the meter movement from damage due to "pinning".

PRECISE DC OUTPUTS FOR EXTRA TASKS

DC output from the voltmeter can be used to drive a relay, recording device, or digital voltmeter. Since there is a physical separation of electronics and meter, the movement may serve the dual function of measuring DC current and voltage directly.

CHOOSE A MODEL TO FIT YOUR EXACT NEEDS

There are 183 standard, solid-state voltmeters offered by Theta. Every one of these is accurate to 2%, has an input impedance of 2 megohms and a sensitivity of 1 MV, and is fully transistorized.

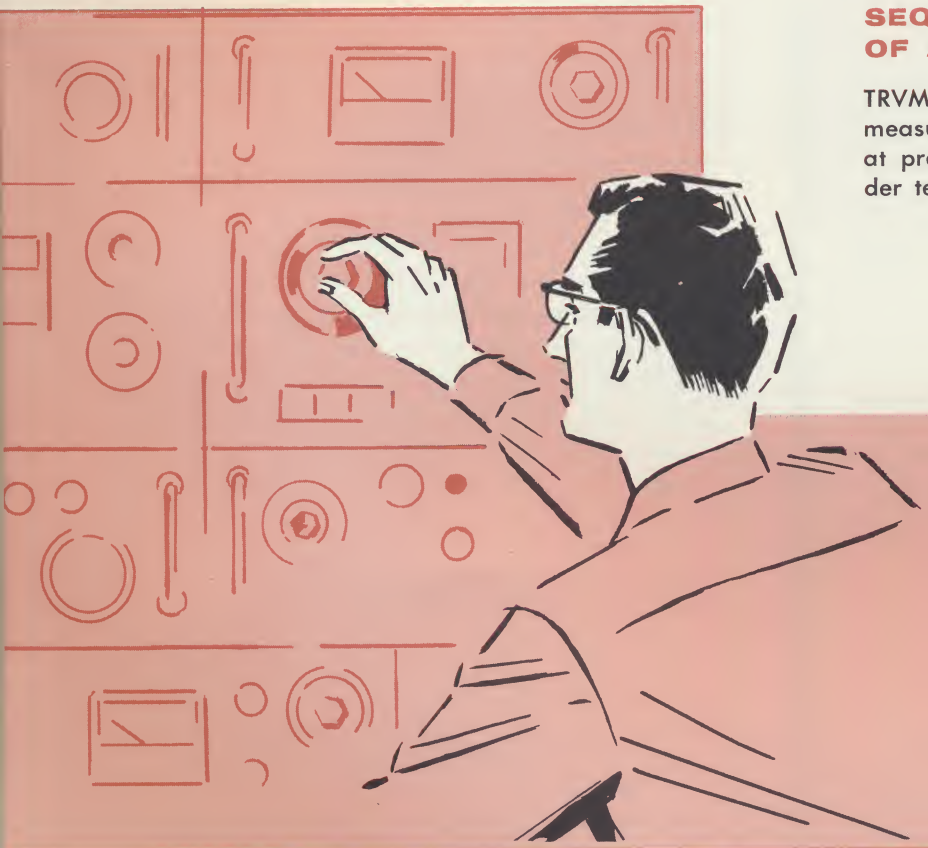
LABORATORY PERFORMANCE

Laboratory instrument characteristics are maintained in Theta's component-size voltmeters: 2% accuracy, 2 megohms input impedance, and 1 MV full-scale sensitivity.

FRONT-PANEL MAINTENANCE

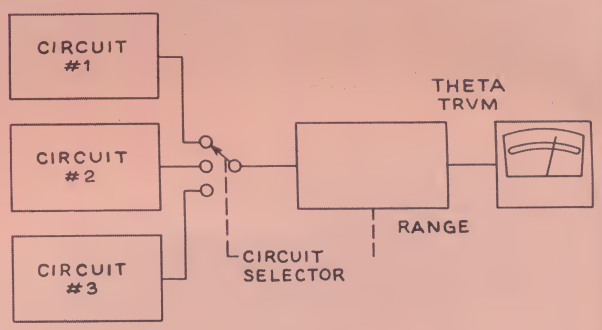
Gain calibration is rarely required — when it is, merely insert a screwdriver through an access hole from the front of your panel.

TRVM FOR BUILT-IN AC MEASUREMENTS



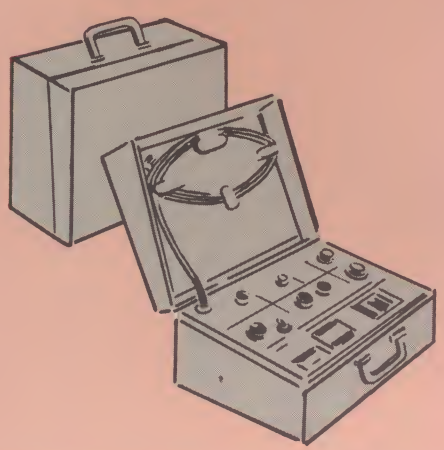
SEQUENTIAL MEASUREMENT OF AC VOLTAGES

TRVM's, integrated into support test equipment, measure the RMS voltages (of sinusoidal inputs) at predetermined points throughout a system under test.



PORTABLE TEST SETS

The low-current requirements and rugged design of the TRVM make it suited for application in portable equipment. It is widely used in flight-line testers. May be powered either with batteries or available field-frequencies.



BETTER PERFORMANCE THAN METER-RELAYS IN LIMIT/ALARM APPLICATIONS

The TRVM with limit/alarm combines the measurement function of a voltmeter with the alarm function of a limit device. It out-performs the meter relay, offering longer life, automatic reset, and voltage measurements beyond the trip point.

The alarm module sensor is a tunnel-diode threshold-switch. When the input voltage reaches a predetermined level (expressed as a percentage of full-scale), the circuit is triggered to energize a sealed relay with DPDT contacts.

Lamps, interruptor-servo, and audible alarms may thus be actuated. So long as the voltage remains above the set-point, the relay continues to be energized. When the input voltage falls below this level, the circuit shuts off by itself. It may cycle "on" and "off" indefinitely in response to the input level without any external reset.

MEASURES LOW LEVEL AC WITHOUT SCREENED ROOM, WITHOUT PROBES

The proximity of powerful AM radio stations is a challenge to accurate millivolt measurements. Theta has designed a low-pass filter into the TRVM which completely attenuates all signals above 40 kc.

TRVM
SPECIFICATIONS

Sensitivity . . . . . Meter deflects full scale with 1 MV AC input when the attenuator is in the most sensitive (1 MV scale) position.

Overall Accuracy . . . Within 2% of full-scale reading.

Input Impedance . . . 2 megohm min. on 1 MV, 3 MV, 10 MV, and 30 MV scales; 4 megohm min. on other scales.

Attenuator Ranges 1 MV, 3 MV, 10 MV, 30 MV, .1 V, .3 V, 1 V, 3 V, 10 V, 30 V, 100 V, 300 V, Off.

Frequency Range . . . 60 cps to 20 kc. 2% accuracy throughout range.

Noise Filter . . . . . 3 db. down at 40 kc; 6 db./octave attenuation.

Signal Overload Capacity . . . . . Up to 350 V AC input with attenuator in any position will not damage electronics or meter.

Power Required . . . . Choose one only of three options:

a. 28 V DC ± 10%, 5% max. ripple, 100 ma. max.

b. 115 V AC ± 5%, 60-800 cps, 100 ma. max.

c. 26 V AC ± 5%, 60-800 cps, 250 ma. max.

Isolation . . . . . Common between signal input lead and 28 V DC lead. Complete isolation between signal and power leads when any AC power option is chosen.

Temperature Range Typical characteristics not including meter movement:

Operating, meets all specs . . . . 15°C to 35°C

Operating, derated specs. . . . . 0°C to 55°C

Operating, no damage . . —10°C to + 85°C

Non-operating, no damage — 10°C to + 100° C

Meter Specifications:

Type . . . . . DC, D'Arsonval

Sensitivity . . . . . 200 microamp DC

Linearity . . . . . 1% of full-scale

Printed Scales . . . Zero left, 0 to 1 and 0 to 3.

Coil Resistance . . 600 ohms ± 10% (external amplifier adjustment permits gain change to compensate for coil resistance)

DC Output:

Voltage . . . . . 120 MV across 600 ohms

Ripple . . . . . Less than 5% of full scale

Linearity . . . . . Better than 1.5% over upper 95% of scale

TRVM ORDERING INFORMATION

TRANSISTORIZED AC VOLTMETERS, MODEL TRVM → [No.] [Ltr] [No.] [Ltr] [No.] [Ltr]

INPUT CIRCUIT
1. Range switch .....

SIGNAL FILTER
A. Wide band, no filter .....
B. 60 cps .....
C. 400 cps .....
D. 800 cps .....

RAW POWER
1. 28 V, DC .....
2. 115 V, AC .....
3. 26 V, AC .....

METER
A. Without meter .....
B. Standard 4¼ in. .....
C. Standard 3½ in. .....
D. Standard 6 in. .....

DIODES & TRANSISTORS
1. Commercial .....

ALARM MODULE
A. Without Alarm Module .....
B. With Alarm Module .....

Shipping Weight ..... 3 lbs.
Terms ..... ½%, 10 days; net 30 days
FOB .....Saddle Brook, New Jersey
Warranty ..... 1 Year

Meter, 5.84 wide x 4.62 high, Part No. C-565-3

Meter, 4 1/16 wide x 4.15 high, Part No. C-565-2

Meter, 3¼ wide x 3¼ high, Part No. C-565-1

OPTIONAL CHARACTERISTICS

TUNED VOLTMETER

An interstage, band-pass filter may be incorporated to reject all input signal frequencies except one. Choose one only of the following nominal pass frequencies: 60 cps, 400 cps or 800 cps.

Meter output is 3 db down at ± 7% of nominal frequency; 40 db down at 3rd-harmonic. Many other filter frequencies are available to suit special requirements.

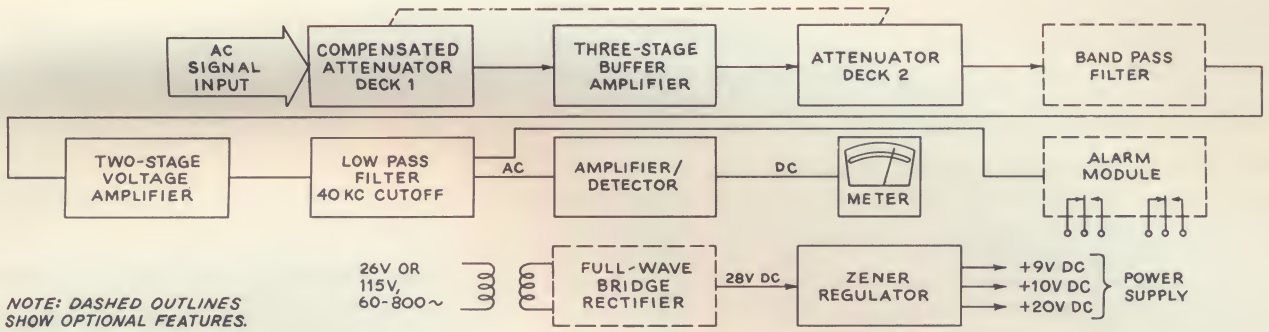
METER MOVEMENTS

Three rectangular styles are available from stock. Any style or size of meter can be used provided that it meets the sensitivity, linearity, and coil resistance requirements shown on page 13.

ALARM MODULE

A tunnel-diode threshold-switch is included within the basic voltmeter package. When the input voltage reaches a predetermined level (expressed as a percentage of full scale) an output relay is triggered to produce closure of DPDT contacts rated at 2 amps. So long as the voltage remains above this level, the relay remains energized. When the input voltage falls below the set point, the circuit shuts off by itself. It may cycle "on" and "off" indefinitely in response to the input level without any external reset. Meter operation is independent of the alarm operation.

ADVANCED TRVM DESIGN



Theta's TRVM employs the widely used principle of signal amplification and peak rectification. The DC current thus produced is used to drive a precision meter. Although the current is proportional to the average signal level, the movement is calibrated in terms of the RMS of a sinusoidal input.

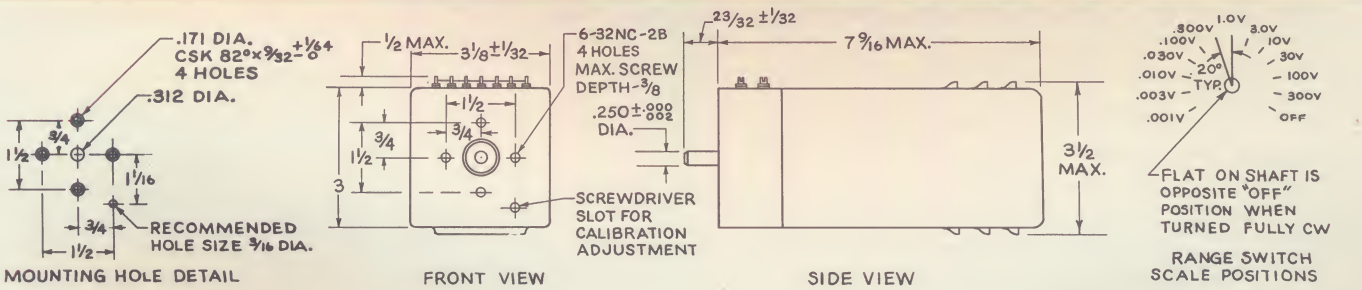
Although the TRVM reading is unusually close to the true RMS voltage in the presence of harmonic distortion, provision has been made for the complete elimination of distortion error through use of a band-pass filter. For example, 50% of 3rd-harmonic distortion might produce a voltage error between −6 V and +4 V for a true RMS input of 100 V.

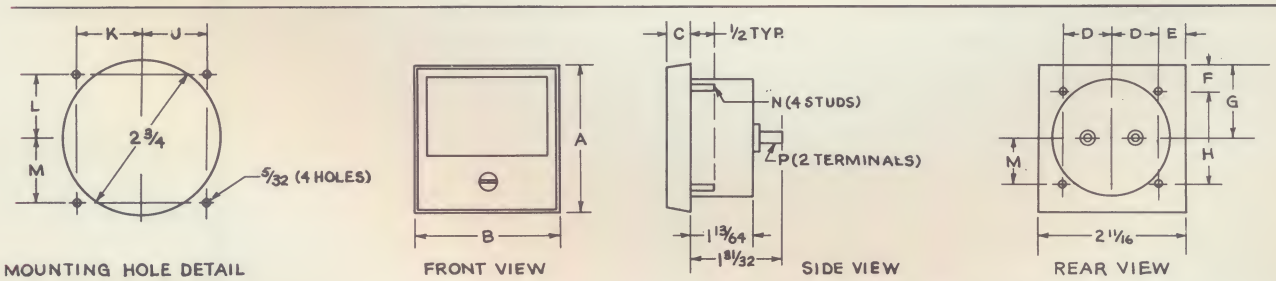
Since the filter attenuates the 3rd-harmonic by 40 db, the error is virtually eliminated and permits the measurement of voltages in the presence of extreme distortion.

A low-pass filter, effectively attenuating all signals above 40 kc, eliminates the local radiation and broadcast-band interference which is so troublesome in AC measurements at high-impedance levels.

For those models which accept a power input of 28 V DC, a zener regulator derives 9 V, 10 V, and 20 V for the various stages. Models operating on AC power feature a transformer input and full-wave bridge rectifier in addition to the zener regulator.

TRVM OUTLINE DRAWINGS





NOTES:
① KNOBS AND SCALE PLATES NOT SUPPLIED
② DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ±1/64
TWO PLACE DECIMALS ±.015
THREE PLACE DECIMALS ±.005
ANGLES ±1/2°.

THETA DWG NO.	DIM A	DIM B	DIM C	DIM D	DIM E	DIM F	DIM G	DIM H	DIM J	DIM K	DIM L	DIM M	THD N	THD P
C-565-1	3¼	3¼	½	1⅛	½	½	1⅝	2¼	1.125	1.125	1.125	1.125	4-40 NC-2	¼-28NF-2
C-565-2	4.15	4 11/16	9/16	2	11/32	19/64	2 5/16	3 9/16	2	2	2.031	1.531	6-32 NC-2	¼-28NF-2
C-565-3	4.62	5.84	9/16	2.62	19/64	13/16	2.97	3	2.62	2.62	2.16	.84	6-32 NC-2	8-32 NC-2

PSVM FOR SOPHISTICATED AC MEASUREMENTS

VOLTAGE RATIO MEASUREMENTS Fig. 1

This circuit is used for the calibration of pots, resistance networks, and transformers as well as the comparison of AC voltages. The PSVM completely eliminates the effect of phase shift and harmonics in either the "master" or the unknown.

SYNCHRO AND RESOLVER ERROR Fig. 2

To measure the electrical error of synchros (or resolvers if the Model RB-11C Bridge is used) in accordance with the pertinent military specifications, the PSVM scale is easily calibrated to read directly in minutes-of-arc when used with Theta's Synchro Bridge, Model SB-11C. Request the SYNCHRO & RESOLVER TEST EQUIPMENT CATALOG for full details.

TRANSDUCER NULLING Fig. 3

Such devices as accelerometers, gyro takeoffs, synchros, resolvers, and microsyns are accurately zeroed with the PSVM. Quadrature and harmonics are eliminated to permit a high gain setting for the in-phase signal component. With this system there is no ambiguity in the choice of a null due to the "directional sense" of the PSVM.

LAG IN A MOVING SERVO Fig. 4

Under dynamic conditions, the CT output in an AC servo should be in the vicinity of null. The amount of fundamental in-phase voltage is **precisely** proportional to the servo lag in minutes-of-arc. It is relatively simple to adjust the PSVM range switch for a direct scale reading in angular units.

MEASURING THE PHASE SHIFT OF AN UNKNOWN

Greatest accuracy for angles less than 5° Fig. 5

a) Adjust the voltage divider until a zero value is obtained upon the PSVM. Then, $E_I = rEs$, where r is the ratio reading upon the divider and Es is the fundamental source voltage which is measured also with the PSVM.

b) Measure E_q, the fundamental quadrature voltage by inserting a 90° phase reference with respect to Es (easily done with the Theta Phase Generator). Without changing the divider's position, the quadrature value in volts, E_q, is indicated upon the PSVM.

c) Calculate θ, the phase shift through the device under test, by the equation $\tan \theta = \frac{E_q}{E_I}$

All angles, 0° to 360° Fig. 5

a) Adjust the ratio box until a zero value is indicated upon the PSVM. The Phase Generator (PG) is in its 0° position.

b) By means of a SPDT switch, connect the 90° output from the PG into the PSVM reference terminals. Rotate the PG dial until the meter indicates zero.

c) Read the phase shift, in degrees, directly from the PG dial.

NULLING TECHNIQUE FOR AC BRIDGES Fig. 6

The Theta PSVM provides unusual sensitivity and accuracy in bridge balancing applications because it eliminates quadrature and harmonic voltages. Bridge elements are varied until both the in-phase and quadrature voltages are zero upon the PSVM. The Theta PG (or an equivalent RC network) is used to provide a 90° (or quadrature) reference into the PSVM. Advantages over the use of an oscilloscope:

a) Since the PSVM rejects harmonics, the measurement is fully independent of harmonic distortion generated in the source or the bridge.

b) Dependence upon identical phase shifts in the X and Y channels is eliminated.

Advantages over the use of AC Voltmeters

Far more sensitive bridge balance due to the elimination of harmonics; also, quadrature (or out-of-phase signals) generated in the bridge itself is eliminated.

Advantages over the use of tuned amplifiers:

Elimination of quadrature.

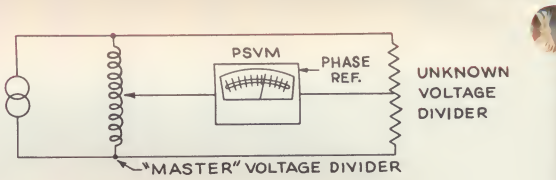


Fig. 1

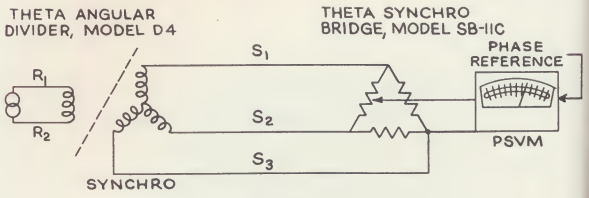


Fig. 2

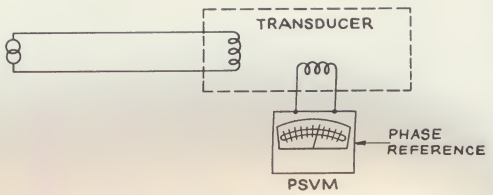


Fig. 3

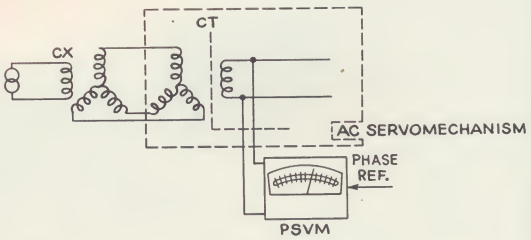


Fig. 4

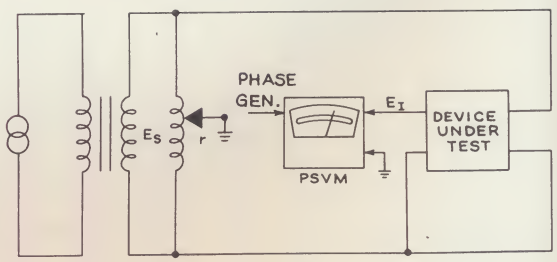


Fig. 5

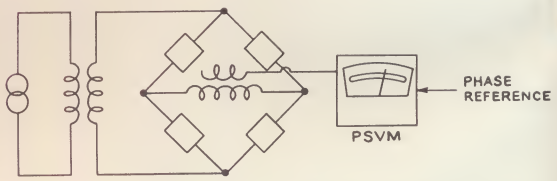


Fig. 6

PSVM
SPECIFICATIONS

Sensitivity . . . . . Meter deflects full scale with 1 MV AC input when the attenuator is in the most sensitive (1 MV scale) position.

Overall Accuracy . . Within 2% of full-scale reading

Input Impedance . . . 2 megohms min. on 1 MV, 3 MV, 10 MV, and 30 MV scales; 4 megohms min. on other scales.

Attenuator Ranges 1 MV, 3 MV, 10 MV, 30 MV, .1 V, .3 V, 1 V, 3 V, 10 V, 30 V, 100 V, 300 V, Off.

Frequency Range . . 60 cps to 2,000 cps

Signal Overload Capacity . . . . . Up to 350 V AC with attenuator in any position will not damage electronics or meter.

Power Required . . . Choose one only of three options:

a. 28 V DC ± 10%, 5% max. ripple, 100 ma. max.

b. 115 V AC ± 5%, 60-800 cps, 100 ma. max.

c. 26 V AC ± 5%, 60-800 cps, 250 ma. max.

Isolation . . . . . Common between signal input lead and 28 V DC lead. Complete isolation between signal and power leads when any AC power option is chosen. Complete isolation between reference input and other circuits.

Quadrature Rejection . . . . . 50 to 1 for twice full-scale voltage input

Reference Signal Requirement . . . . . Choose one only of two options:

AC VOLTS	INPUT IMPEDANCE
26 V ± 10%	50,000 ohms, minimum
115 V ± 10%*	50,000 ohms, minimum

DC Output:

Voltage . . . . . ± 60 mv across 600 ohms

Ripple . . . . . Less than 5% of full scale

Linearity . . . . . Better than 1.5% over upper 95% of scale

Meter Specifications

Type . . . . . DC, D'Arsonval

Sensitivity . . . . . 100-0-100 microamps

Linearity . . . . . 1% of full scale

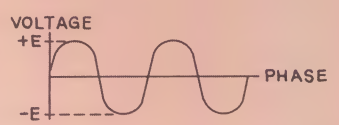
Coil Resistance . . 600 ohms ± 10% (external amplifier adjustment permits gain change to compensate for coil resistance)

Printed Scales . . . Zero center, 1-0-1 and 3-0-1

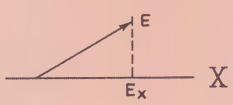
**With 115 V reference option, the wide-band frequency range is 200 cps to 2,000 cps.*

WHAT IS A PSVM?

Basically it is a device which accepts an AC input signal:

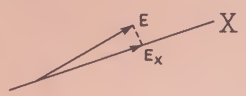


This may be represented in vector fashion as:



Through unique circuitry which is variously described as "multiplier" or "demodulator" or "discriminator" this vector signal is resolved into one of its components, E_X.

The orientation of the x-axis is chosen by the phase reference which is applied to the PSVM during use. It may for instance, look like this:



The vector component, E_X, is often called the in-phase component. The DC signal at the output of the PSVM is directly proportional to the voltage E_X. Thus, the PSVM produces a DC output whose amplitude and polarity are proportional to the amplitude and phase angle of the AC input. If the input is in-phase with the reference, the output is positive; if the signal is 180° out of phase, the output is negative.

PSVM ORDERING INFORMATION

PHASE SENSITIVE VOLTMETER, MODEL PSVM-

No.	Ltr	No.	Ltr	No.	Ltr	No.	Ltr

INPUT CIRCUIT
1. Range switch .....

SIGNAL FILTER
A. Wide band, no filter .....
B. 60 cps .....
C. 400 cps .....
D. 800 cps .....

RAW POWER
1. 28 V, DC .....
2. 115 V, AC .....
3. 26 V, AC .....

REFERENCE POWER
A. 26 V, AC .....
B. 115 V, AC .....

ALARM MODULE
1. Without Alarm Module .....
2. With Alarm Module .....

REFERENCE FILTER
A. Without Reference Filter .....

METER
1. Without meter .....
2. Standard 4¼ in. .....
3. Standard 3½ in. .....
4. Standard 6 in. .....

DIODES & TRANSISTORS
A. Commercial .....

Shipping Weight ..... 3 lbs.
FOB .....Saddle Brook, New Jersey
Terms ..... ½%, 10 days; net 30 days
Warranty ..... 1 Year

Meter, 5.84 wide x 4.62 high, Part No. C-566-3

Meter, 4 1/16 wide x 4.15 high, Part No. C-566-2

Meter, 3¼ wide x 3¼ high, Part No. C-566-1

OPTIONAL CHARACTERISTICS

SIGNAL FILTER

The equivalent circuit of the PSVM may be considered a low-pass filter. Even harmonics of the signal are completely attenuated; odd harmonics are attenuated as follows: 3rd, 3 to 1; 5th, 5 to 1; 7th, 7 to 1; etc. When still more filtering is necessary due to exceptionally distorted signals, an interstage, band-pass filter may be specified. All input frequencies, except one, will be rejected. Choose one only of the following nominal pass frequencies:

60 cps , 400 cps or 800 cps.

Meter output is 3 db down at ± 7% of nominal frequency; 40 db down at 3rd harmonic. Many other filter frequencies are available to suit special requirements.

SPECIAL FREQUENCIES

PSVM'S can be adjusted for restricted bands from 50 cps to 35 kc.

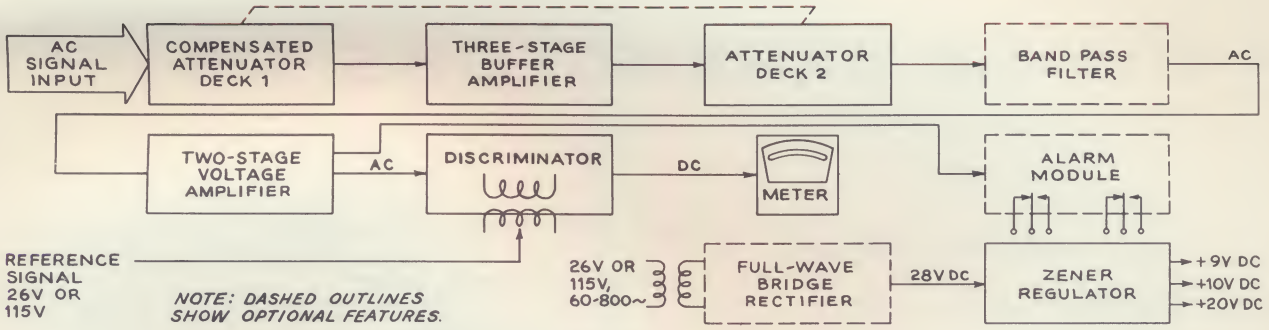
ALARM MODULE

In many nulling applications it proves helpful to know when the rejected signals (average AC voltage input) are near the saturation level of the voltage amplifier. This would, of course, have an effect upon the overall accuracy. A miniature sealed relay is actuated by a level-sensitive tunnel-diode. The DPDT relay contacts rated at 2 amps, are used to drive lamps, audible alarms, or marker signals.

METER MOVEMENTS

Three rectangular styles are available from stock. Any style or size of meter can be used provided that it meets the sensitivity, linearity, and coil resistance requirements shown on page 17.

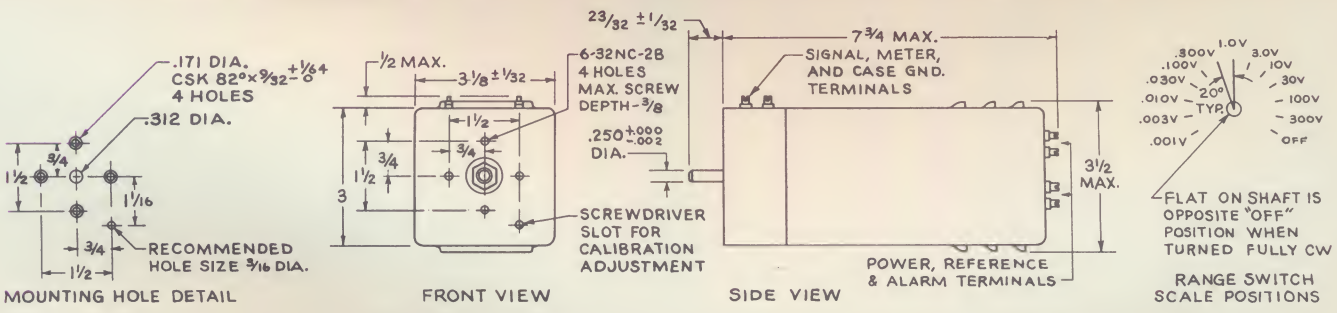
PSVM DESIGNED FOR VOLTAGE AND PHASE SENSITIVITY

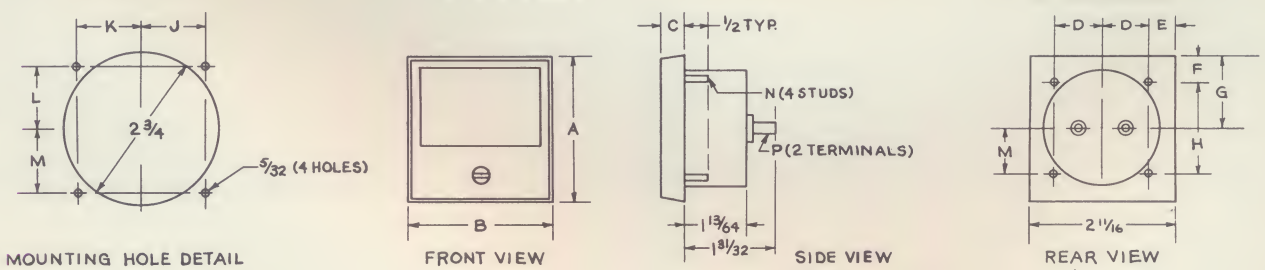


At the PSVM input, a unique attenuator reduces the incoming signal to the level of the succeeding stages. Neither the signal magnitude nor its phase shift at any tap will alter as a function of signal frequency. Signal isolation is achieved by means of a three-state emitter-follower (input impedance, 10 megohms; output impedance, 50 ohms). There is a diode circuit located at the emitter follower's input to protect all succeeding stages against over-voltage. Driving the demodulator is a 2-stage voltage amplifier with double-ended output. This stage is effectively a solid-state switch which is triggered by the reference signal. It passes to the meter movement a portion of the input signal only during cyclic time intervals determined by the applied reference voltage.

An opional alarm module employs a tunnel diode to actuate an internal, sealed relay when the total AC signal exceeds twice the voltage for which the range switch is set. During nulling operations, the alarm notifies the operator when the circuits are being saturated.

PSVM OUTLINE DRAWING





NOTES:
Ⓐ KNOBS AND SCALE PLATES NOT SUPPLIED
Ⓑ DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ±1/64
TWO PLACE DECIMALS ±.015
THREE PLACE DECIMALS ±.005
ANGLES ±1/2°

THETA DWG NO.	DIM A	DIM B	DIM C	DIM D	DIM E	DIM F	DIM G	DIM H	DIM J	DIM K	DIM L	DIM M	THD N	THD P
C-566-1	3¼	3¼	½	1⅛	½	½	1⅝	2¼	1.125	1.125	1.125	1.125	4-40 NC-2	¼-28NF-2
C-566-2	4.15	4 11/16	9/16	2	11/32	19/64	2 5/16	3 9/16	2	2	2.031	1.531	6-32 NC-2	¼-28NF-2
C-566-3	4.62	5.84	9/16	2.62	19/64	13/16	2.97	3	2.62	2.62	2.16	.84	6-32 NC-2	8-32 NC-2

PHASE GENERATORS

- Phase shifts 360° continuously
- Constant amplitude output
- Easy panel mounting
- Direct reading of phase shift
- Passive, rugged construction

MODEL PG-9

Phase accuracy, 1.5°

Also available with other dial markings. See page 9 of this catalog.

FOR PHASE SHIFTING AND MEASURING

Apply an AC input and it is phase shifted — continuously without amplitude change — at the turn of a dial. Read the exact value of phase shift from the dial face.

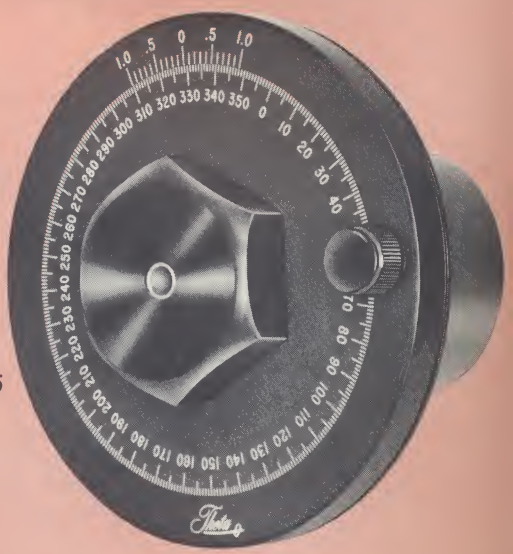
MODEL PG-5

Servo-mounted, shaft-to-phase transducer. Phase accuracy, 20 min.-of-arc.

MODEL PG-3

Phase accuracy, 30 min.-of-arc.

Also available with any of the Dial Assemblies on pages 4 and 5 of this catalog.



HOW THEY WORK

Resistor and capacitor networks split an applied voltage into two equal components differing from each other by a 90° time phase. A high precision resolver creates a space analogue to these two vectors and resolves them along any vector axis defined by the shaft position. The resultant has a time phase which is equal in angle to the resolver shaft angle.

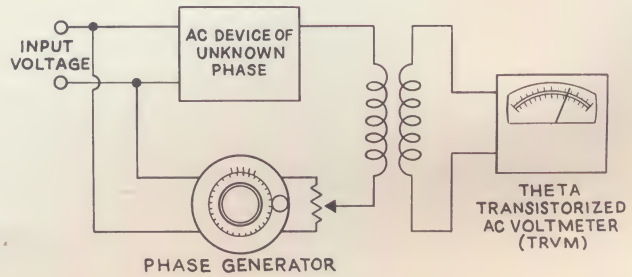
PHASE GENERATOR APPLICATIONS

MEASURING PHASE AND AMPLITUDE OF UNKNOWN

Rotate the PG dial until the Theta Transistorized Voltmeter (TRVM) indicates null. At this point the PG output and the unknown are in phase. Read the phase of the unknown on the PG dial.

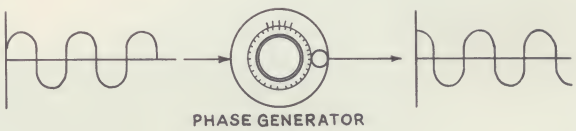
A Theta TRVM with an integral band-pass filter will provide better nulling sensitivity since it eliminates the residual harmonics. For still greater sensitivity a Theta Phase-Sensitive Voltmeter (PSVM) may be chosen instead of the TRVM.

Should the amplitude of output from the PG and the unknown differ, then a linear voltage divider may be shunted across the PG output. To find the gain (or attenuation) and phase shift through the unknown, use this procedure: Turn the PG dial (which is the phase control) until the TRVM shows null. Rotate the voltage divider (the gain control) for another TRVM null. Read the unknown's phase upon the PG dial. The unknown's amplitude is the divider-ratio times the PG output. The PG output can be set, prior to the test, to bear a fixed relationship to the input.



PHASE SHIFTING FOR TIME-BASE APPLICATIONS

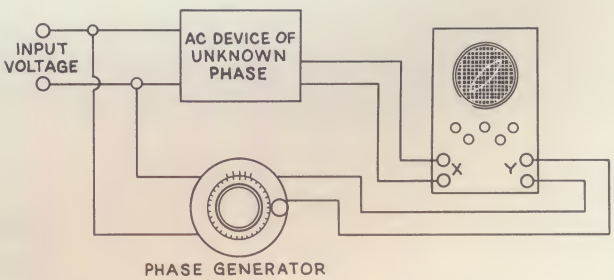
Most frequently used in radar and loran systems for phase shifting a sinusoidal wave train through 360°. Of particular interest in this application is the PG's low harmonic distortion, immunity to loading, and infinite resolution.



PHASE MEASUREMENT WITH AN OSCILLOSCOPE

Rotate the PG dial until a straight line appears on the oscilloscope. At this point, the PG output and the unknown are in phase. The PG dial indicates the phase of the unknown.

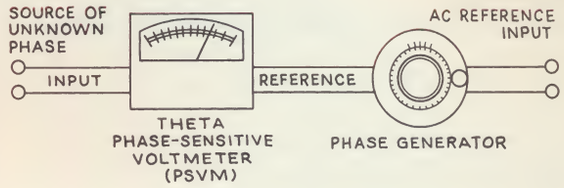
Any harmonic distortion present in the output of the PG or unknown will produce looping of the pattern, making the straight line closure difficult to determine. To set the zero of the PG, by-pass the unknown, adjust the PG for a straight line pattern, and set its dial to zero.



PHASE MEASUREMENT WITH A PHASE-SENSITIVE VOLTMETER

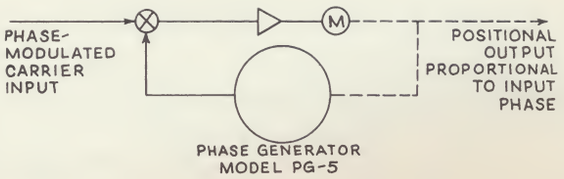
The Phase-Sensitive Voltmeter (PSVM) is a device which produces a DC output proportional to the cosine of the phase difference, θ, between the input and reference circuits.

To measure phase, the PG dial is rotated until the meter indicates zero output. When this condition occurs, θ must be 90° and cos θ must be zero. In order to determine the dial "zero," connect the PSVM input to the AC reference and turn the PG dial until the meter is at zero. Set the PG dial to read 90° at this point.



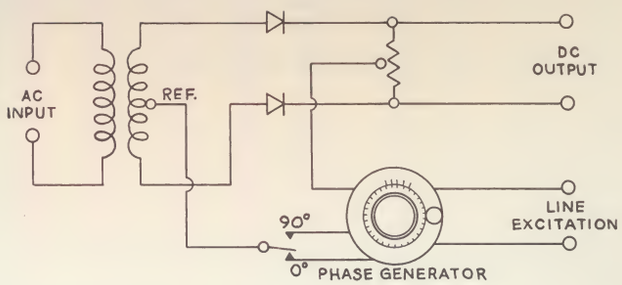
USE IN SERVO-DRIVEN APPLICATIONS

The Model PG-5 is a servo mounted, low inertia, low friction Phase Shifter which is ideally suited for motor-driven applications. The phase error remains within 20 minutes of arc due to the absence of dial errors. When it is desired to convert phase modulation into a shaft rotation or vice versa, this unit is recommended.



USE AS A REFERENCE FOR PHASE-SENSITIVE DEVICES

In demodulator (AC to DC) and modulator (DC to AC) circuits, a reference phase must be provided for proper operation. The PG proves useful especially where a wide range of phase values is required. Since PG output amplitude is independent of phase, the demodulator or modulator circuit does not require any readjustment as the phase is changed. In many applications it is desirable to insert either an in-phase reference or one that is 90° with respect to it. The PG provides two outputs which are in quadrature to each other, facilitating such switching.



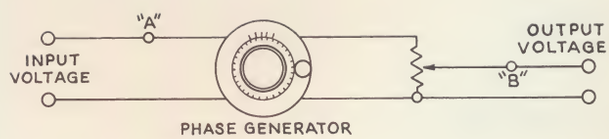
COMBINING R, L, & C WITH THE PHASE GENERATOR

Loading the Output

The PG output can be loaded with any R, L, or C down to zero impedance. However, the lower the shunting impedance, the lower will be the PG output voltage. For each load, the dial must be re-zeroed between points A and B.

Variation of PG Output Voltage

The PG output voltage can be controlled by the method shown. However, the dial must be re-zeroed between points A and B. The voltage divider pictured above may be any one of several available types.



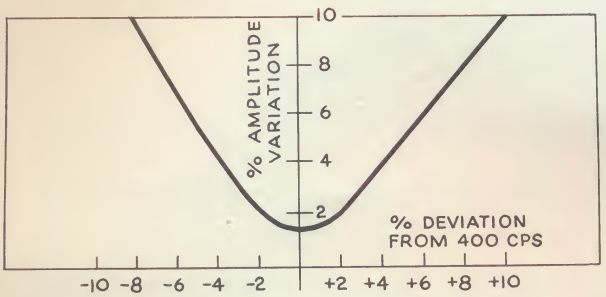
PERFORMANCE CHARACTERISTICS

FREQUENCY CHARACTERISTICS

PG networks are frequency sensitive. At the factory each network is aligned with an excitation frequency which is within 0.1% of the nominal value. The excitation source should have a frequency stability consistent with the phase accuracy which the application demands. PG's can be adjusted for any single frequency between 50 cps and 15 kc.

The error caused by frequency drift during use is approximately 16 minutes of phase error for each 1% variation in excitation frequency.

AMPLITUDE CHARACTERISTICS



AMPLITUDE VARIATION vs FREQUENCY

Since the ratio of output voltage to input voltage is essentially constant, lowering the input will accordingly lower the output.

As the PG is rotated through 360°, its output amplitude varies slightly as follows:

Model	% Amplitude Variation
PG-9	2.5% Max.
PG-3	1.0% Max.
PG-5	1.0% Max.

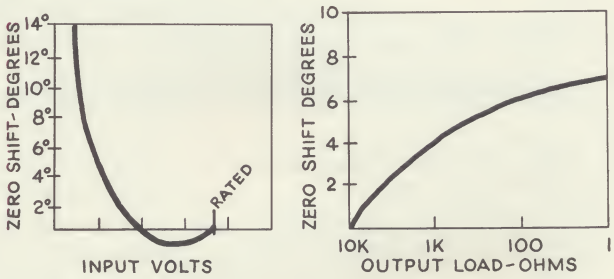
Frequency drift of the power source will further increase these variations as shown in the Amplitude Variation vs. Frequency curve.

WAVEFORM

A bandpass filter is built into the PG resulting in harmonic attenuation. The higher the frequency, the less harmonic distortion will be found in the input.

ZERO-SHIFT

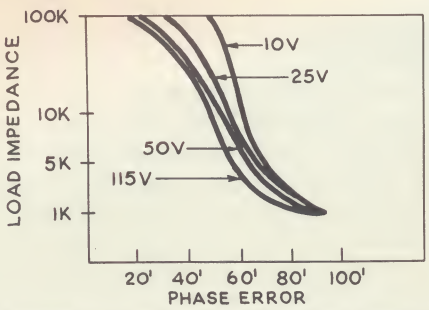
The effect of input voltage and loading upon the zero setting of the dial is shown. A simple means has been provided to re-zero the dial. By inserting a screwdriver through the coaxial hole in the dial, the zero may be adjusted with respect to any reference for any set of operating conditions.



ZERO SHIFT vs INPUT VOLTAGE LOAD

LOADING CHARACTERISTICS

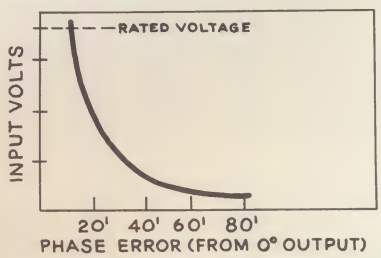
One of the unusual features of the PG is its relative insensitivity to loading. At rated input, there is no additional phase error when the load is decreased to 100 K.



PHASE ERROR vs LOADING AT VARIOUS INPUT LEVELS

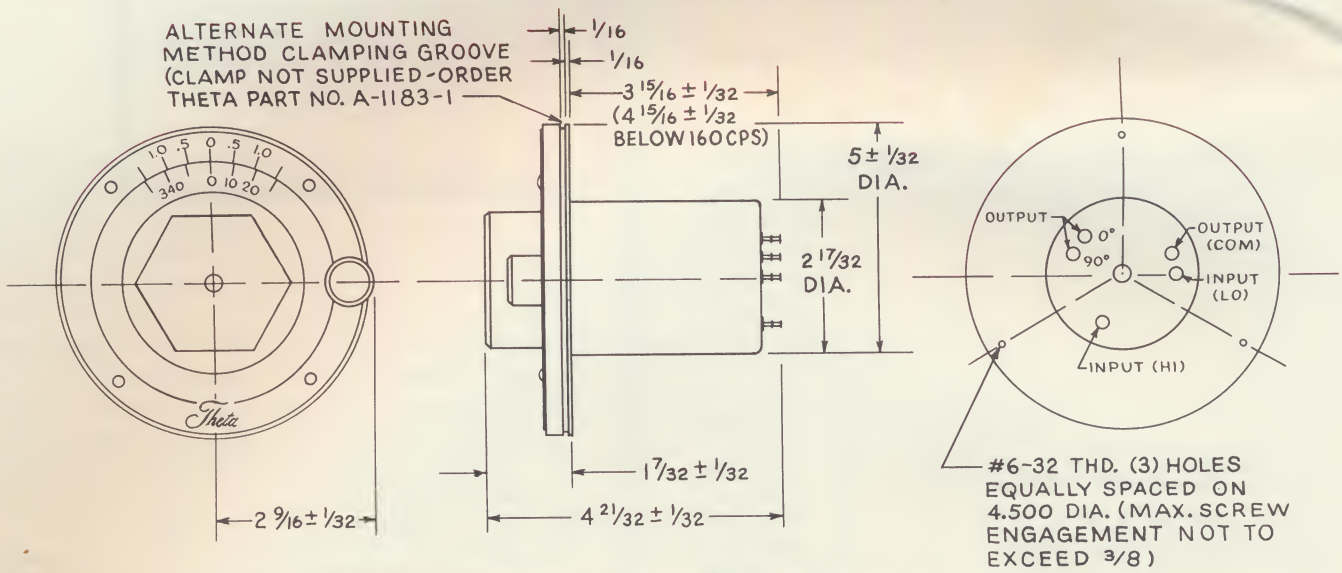
IMPUT VOLTAGE CHARACTERISTICS

PG's may be used from zero to rated voltage without any danger or damage. Above rated voltage, the ratings of internal components may be exceeded. In general, one may operate from ½ to full rated input without any sacrifice of phase accuracy.

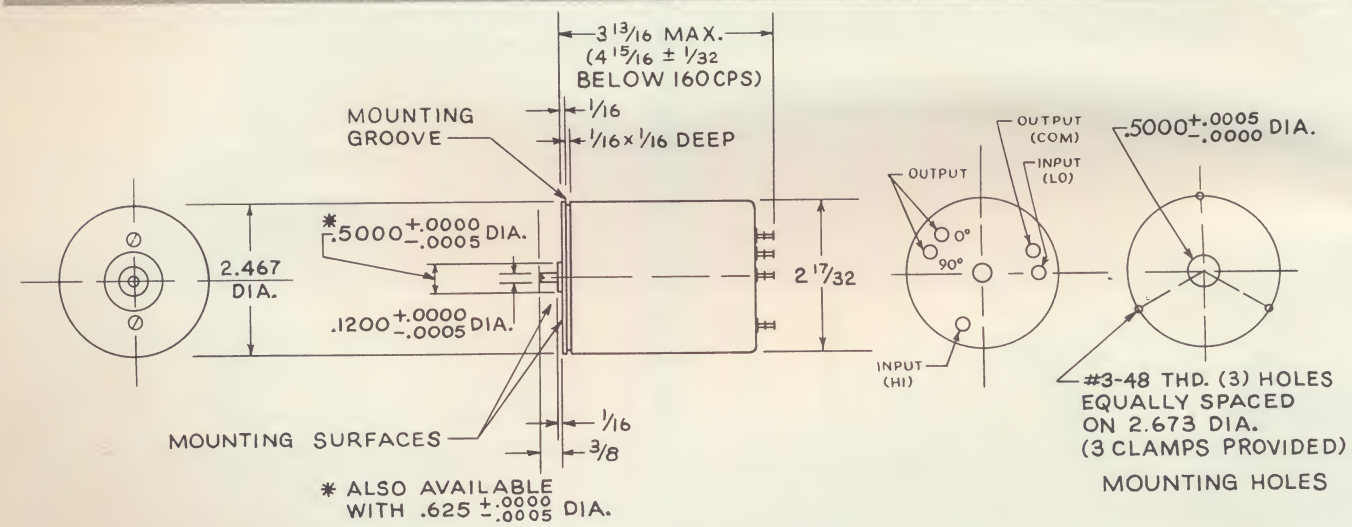


INPUT VOLTAGE vs ACCURACY

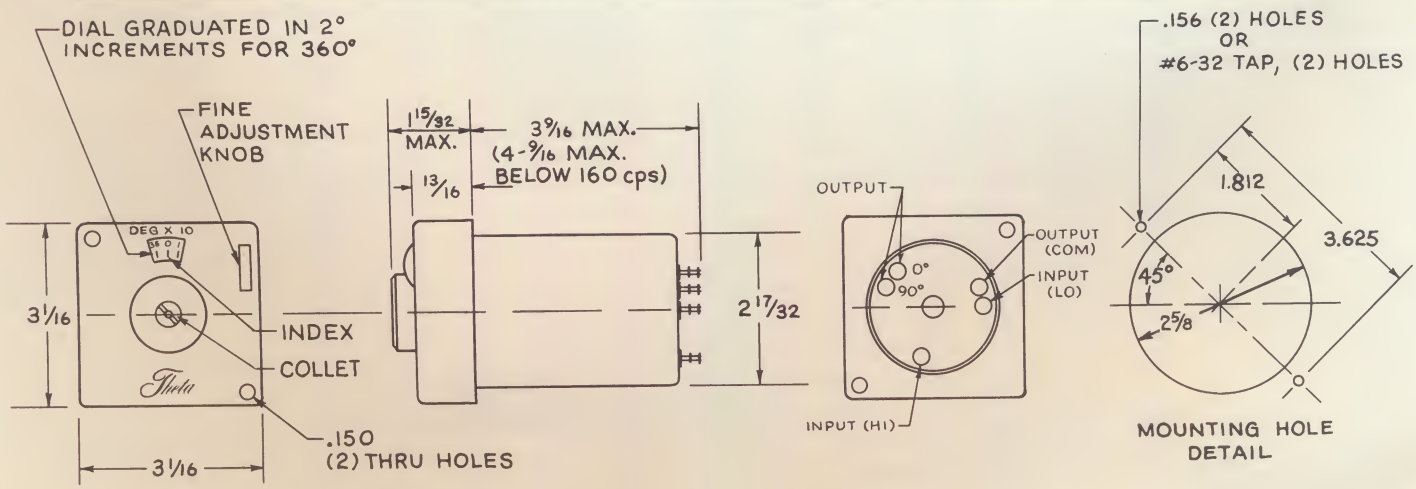
PHASE GENERATOR OUTLINE DRAWINGS



PHASE GENERATOR MODEL PG-3



PHASE GENERATOR MODEL PG-5



PHASE GENERATOR MODEL PG-9

Theta INSTRUMENTS TO REPEAT ANGULAR POSITION

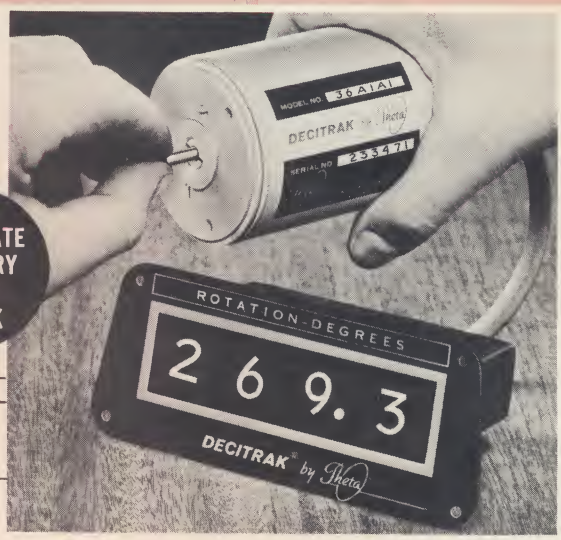
DECITRAK®

AN ALL NEW SHAFT ENCODER

- **DECIMAL OUTPUT** — generates 10 wire/digit code directly — no expensive translation from binary, BCD or Gray.
- **LOWER COST** — less than **half** the price of conventional encoders.
- **ON-THE-FLY OUTPUT** — instantaneous, continuous output to lampbanks or printers while the shaft rotates at full speed.
- **DIRECT LAMPBANK OR PRINTER ACTUATION** — simply connect. Converters not required.
- **5-10 TIMES LONGER LIFE**
- **PATENTED NEW PRINCIPLE ENSURES UNUSUAL RELIABILITY**

® DECITRAK is a registered trade name. Patent Pending

IMMEDIATE DELIVERY FROM STOCK



	STANDARD MODELS	
No. of Shaft Revolutions for Full Range	Numerical Readout	Accuracy
36	000.0° to 359.9°	1 part in 3,600
1	000.0° to 359.9°	1 part in 1,800
36	—179.9° to +179.9°	1 part in 3,600
1	—179.9° to +179.9°	1 part in 1,800
100	0000 to 9999	1 part in 10,000
10	0000 to 9999	1 part in 5,000
1	00′ to 59′	1 part in 60

Many other numerical scales and integral gear heads may be chosen.

SERVO REPEATERS

Precise Position Repeater, MODEL PPR-22
Features in-line digital readout
Model PPR-20 with counter readout.

DISPLAY POSITION of REMOTE SYNCHROS and RESOLVERS IN DIGITAL FORMAT

- 6 min.-of-arc follow-up accuracy
- Fully automatic — without gain/phase/stability — adjustments
- Solid-state construction for maximum reliability and low power drain
- Clear visual readout plus direct decimal-code to drive printers and alarms
- Eliminates line-length problems of conventional servos
- Full accuracy in the presence of signal harmonics and quadrature
- Independent of carrier phase shift
- Independent of line-frequency fluctuations

SUPERIOR CHARACTERISTICS

ANGULAR ACCURACY	6 min.-of-arc
RANGE	0° through 360°
SCALES	0° to 359.9°, ±179.9°, 0 to 9999 and many others are available
SLEWING SPEED	180° in 6 seconds
ELECTRICAL OUTPUT	CODE: Decimal, parallel format. OUTPUT: 24V DC, 40 ma. in "ON" or "1" condition
VISUAL DISPLAY	4 digits, ¾ in. character ht.

SYSTEM ERROR BRIDGES

For ULTRA-PRECISE tracking and measurement of synchro and resolver systems.

- **Accuracies from 10 seconds-of-arc**
- **Continuous, 0° through 360°**
- **Resolution from 1 second-of-arc**

IMMEDIATE DELIVERY FROM STOCK

Prices start at

WRITE FOR COMPLETE 28 PAGE CATALOG

TEST EQUIPMENT FOR SYNCHROS AND RESOLVERS

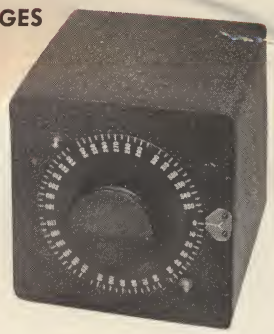
SYNCHRO AND RESOLVER TEST SETS

- Perform MIL spec and SAE tests
- Many models and price ranges
- Stock delivery or 4 weeks

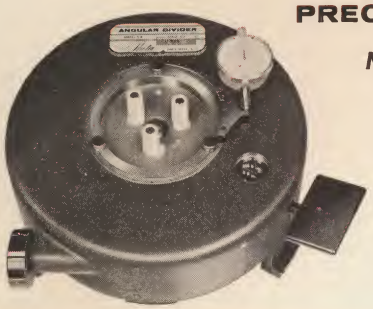
SYNCHRO AND RESOLVER BRIDGES

- Perform error tests strictly in accordance with MIL spec and SAE procedures
- Certified accuracies to 2 sec.-of-arc
- Lowest prices anywhere
- Many models — manual or automatic

From



PRECISION ANGULAR DIVIDERS



MODEL D-4

- Positions synchros, resolvers and pancakes with less than 15 sec.-of-arc error
- Delivery from stock
- Used and accepted by synchro manufacturers and government organizations

—55 TO +130°C PERFORMANCE

ASK ABOUT THE MODEL D-5

. . . a specially fitted version of the Angular Divider which can be installed within a temperature chamber (ungainly and inaccurate adapters gone forever). Use it to test your rotary components from **—55°C to +130°C.** Its error will not exceed 25 sec.-of-arc at any angle at any temperature!

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